REMARKS

The above-identified patent application has been amended and Applicants respectfully request the Examiner to reconsider and again examine the claims as amended.

Claims 1 and 4-38 are pending in the application. Claims 1, 9-11, 13-18, 25, 27-30, 32, and 33 are rejected. Claims 9 and 29 are amended herein. Claims 12, 26, and 31 are objected to. Claims 36-38 are new.

Claims 4-8, 19-24, 34, and 35 were previously withdrawn in accordance with an election filed August 26, 2005 in response to a Restriction Requirement dated July 26, 2005. Of the withdrawn claims, Claims 4-8 were withdrawn pending allowance of independent Claim 1, from which they depend, and should be allowable upon allowance of Claim 1. Claims 19-24, 34, and 35 are canceled herein without prejudice according to the previous withdrawal of those claims.

Applicant's attorney would like to thank Examiner Ngo for the courtesy extended during the telephone interview with Applicant's attorney, Kermit Robinson, on June 14, 2006. The inventions of Claims 1, 25, and 29 were discussed in view of references by Steiner et al. (U.S. Patent No. 6,356,068) and Stauth et al. (U.S. Publication number 2004/0155644).

With regard to Claim 1, the Examiner asserted that the claimed bend direction of the leads is not patentably distinct over generally known lead bendings. Applicants provide remarks below with regard to existing Claim 1.

With regard to independent Claim 25, which was not discussed by the Examiner in the present or prior Office Actions, the Examiner asserted that the claimed "...current conductor portion having a cross section with a predetermined shape selected to provide an increased flux density" is not shown in FIG. 6, which was elected in a Response to a Restriction Requirement,

the Response dated August 26, 2005. Therefore, the Examiner believes that Claims 25-28 should be canceled. However, Applicants respectfully point out that similar claims 12, 26, and 31 are objected to but would be allowable according to the present Office Action. Of these claims, Claim 26 depends from Claim 25. Applicants also respectfully point out that similar Claims 19, 27, and 32 are commented upon in the present Office Action. Therefore, Applicants request further consideration of Claims 25-28, or further clarification, particularly in view of Claim 26, which would be allowable according to the present Office Action.

With regard to independent Claim 29, which also was not discussed by the Examiner in the present or previous Office Actions, the Examiner expressed that the claimed "...current conductor portion comprises a loop having an inner dimension..." can be found in Steiner et al, for example, in FIG. 5, as a coupling of two of the leads of element 5. Claim 29 is amended herein and is discussed below.

The Rejections under 35 U.S.C. §103(a)

The Examiner rejects Claims 1, 9-11, 13-18, 25, 27-30, 32, and 33 under 35 U.S.C. §103(a) as being unpatentable over Steiner et al. (U.S. Patent number 6,356,068) in view of Stauth et al. (U.S. Publication number 2004/0155644). With regard to Claim 1, the Examiner recognizes that Steiner et al. "...does not disclose each of the leads...has a bend in a direction selected to result in each of the leads being closer to the first surface of the substrate than to the second surface of the substrate ... ." The Examiner relies upon Stauth et al. as teaching this feature. The Examiner concludes that "[i]t would have been obvious to one having ordinary skill in the [art] at the time the invention was made to modify the lead portion of Steiner et al. by bending in a direction selected to result in each of the leads being closer to the first surface of the substrate for the purpose of easily mounting to a circuit board... ." Applicants respectfully disagree.

As the Examiner is aware, and as found in MPEP §2142, in order to establish a prima facie case of obviousness "...the prior art reference (or prior art references when combined) must

teach or suggest all the claim limitations." Applicants respectfully submit that the Examiner has not met this burden in order to establish prima facie obviousness.

Applicants submit that Claim 1 is patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "*...each one of the leads has a bend in a direction selected to result in each one of the leads being closer to the first surface of the substrate than to the second surface of the substrate throughout the length of the lead*," as set forth in Claim 1.

The present invention provides an arrangement (e.g., as shown in FIG. 6) for which a substrate 166 is mounted in an integrated circuit 150 in conjunction with a lead frame 152 having a current conductor portion 154 (coupling of leads 152a, 152b with leads 152c, 152d) such that the substrate 166 has an orientation that is upside down (i.e., the first surface 166a is directed downward) relative to a conventional orientation with which a substrate is mounted in an integrated circuit package. The substrate 166 has a magnetic field transducer 158 diffused into the first surface 166a, or otherwise disposed on the first surface 166a. The first surface 166a, which includes the magnetic field transducer 158, is directed downward toward the current conductor portion 154.

The Examiner uses FIG. 8 of Stauth et al. to show the claimed arrangement having leads bent as recited in Claim 1. Applicants submit that Stauth et al. does not show the claimed arrangement at all. In the claimed arrangement, as recited in Claim 1, the "*one or more magnetic field transducers [are] disposed on the first surface of said substrate*." Therefore, the corresponding first surface of the substrate 504 (FIG. 8) of Stauth et al. is upward. Therefore, the second surface of the substrate 504 is downward, and the second surface is closer to the leads 516, 518 than the first surface. Stauth et al. fails to describe or suggest the claimed arrangement, in which "each one of the leads has a bend in a direction selected to result in each one of the leads being *closer to the first surface of the substrate than to the second surface of the substrate throughout the length of the lead*."

The claimed arrangement provides at least one particular *unexpected and technically significant advantage*. The claimed arrangement results in the magnetic field transducer 158 being in very close proximity to the current conductor portion 154 as described, for example, at page 2, beginning at line 24 and at page 10, beginning at line 28. Therefore, the current sensor 150 has a high sensitivity.

Referring first to Steiner et al., the arrangement of Steiner et al. includes a current path 5 and two Hall generators 2. However, because Steiner et al. uses glue tape 3 between the Hall generators 2 and the current path 5 (see, e.g., Fig. 1 of Steiner et al.) in accordance with a conventional lead-on-chip (LOC) manufacturing process, the Hall generators 2 of Steiner et al. are further away from the current path 5 than is achieved with the present invention. Steiner et al. states, at column 4, lines 64-65 that "[t]his glue tape has a final thickness of 0.09 mm... ," which spaces the Hall generators 2 from the current path 5 by at least 0.09 mm.

Applicants further submit that even if the leads of Steiner et al. were bent in an opposite direction than shown, for example, in Fig. 7 of Steiner et al., still the close proximity of the claimed magnetic field transducers to the current conductor portion described above would not be achieved. Using the conventional LOC process, which requires the glue tape 3, the Hall generators 2 of Steiner et al. would not be as close the current path 5 as is achieved with the present invention.

Furthermore, as the Examiner is aware, and as found in MPEP §2142, in order to establish a prima facie case of obviousness "...there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings." Applicants respectfully submit that the Examiner has not met this burden in order to establish prima facie obviousness.

With regard to Claim 1, Steiner et al. clearly describes throughout his specification that the process used to generate his integrated circuit is a conventional "lead-on-chip" (LOC) process. For example, in the abstract, Steiner et al. states, "[a] fully packaged current monitor system for galvanically isolated current measurement is manufactured in line with *commercial IC fabrication and LOC packaging technology*." [emphasis added] One of ordinary skill in the art will understand that the conventional LOC process results in an integrated circuit having a form represented by Fig. 7 of Steiner et al. for which the leads are bent in a particular direction, and wherein the leads are closest to different surfaces of the substrate along different parts of lengths of the leads. In contrast, Claim 1 requires that "each one of the leads has a bend in a direction selected to result in each one of the leads being *closer to the first surface of the substrate than to the second surface of the substrate throughout the length of the lead*." Applicants submit that, using the conventional LOC process, Steiner et al. would not be motivated to bend his leads in an unconventional way. The bend direction of the leads suggested by the Examiner would require unconventional LOC manufacturing equipment.

As described above, the Examiner concludes that "[i]t would have been obvious to one having ordinary skill in the [art] at the time the invention was made to modify the lead portion of Steiner et al. by bending in a direction selected to result in each of the leads being closer to the first surface of the substrate for the purpose of easily mounting to a circuit board... ." However, Applicants submit that Steiner et al. would not be motivated to change the bend direction of his leads since changing the bend direction would result in an integrated circuit no more easily mounted to a circuit board that the arrangement already described by Steiner et al.

In view of the above, Applicants submit that Claim 1 is patentably distinct over Steiner et al. in view of Stauth et al.

Claims 9-11 and 13-18 depend from and thus include the limitations of Claim 1. Thus, Applicants submit that Claims 9-11 and 13-18 are patentably distinct over the cited references at least for the reasons discussed above in conjunction with Claim 1.

Applicants submit that amended Claim 9 is further patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "... said substrate is coupled to said lead frame with a selected one of a solder ball, a gold bump, a eutectic and high lead solder bump, a no-lead solder bump, a gold stud bump, a polymeric conductive bump, or an anisotropic conductive paste coupled to a corresponding one of the plurality of leads," as set forth in amended Claim 9.

Applicants submit that Claim 13 is further patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "... *at least a portion of said current conductor portion has a rectangular cross section having a minimum dimension less than a thickness of said lead frame*," as set forth in Claim 13. With this arrangement, at least a portion of the claimed current conductor portion, which is a part of the lead frame, is thinned. Advantages of this arrangement are described, for example, in conjunction with FIG. 9, at page 18, lines 9-19, where it is described that:

> It will be recognized that, in the presence of a current passing through the current conductor portion 254, the current conductor portion 254 being thinner, for example, than the current conductor portion 74 of FIG. 3, has a higher current density near the surface 254a than the current conductor portion 74 of FIG. 3 has near the surface 74a in the presence of a similar current. In other words, the current is compressed to be closer to the surface 254a than it would otherwise be with a thicker current conductor portion. As a result, a magnetic field generated by the current has a higher flux density in proximity to the surface 254a.
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> Therefore, when the lead frame 250 is used in place of the lead frame 72 of FIG. 3, the Hall effect elements 78a, 78b experience a greater magnetic field, resulting in a more sensitive current sensor.

The Examiner asserts that Steiner et al. and/or Stauth et al. show the claimed arrangement, but does not specifically point out where this arrangement can be found in Steiner et al. or Stauth et al. Applicants submit that the lead frame and the current conductor of Steiner et al. have a uniform thickness. Applicants also submit that the conductors of Stauth et al. (e.g.,

conductor 364 of FIG. 6A) are not a current conductor portion as claimed, which is formed as recited in Claim 1 of the present application, by "a coupling of at least two of the plurality of leads." Therefore, the conductors of Stauth et al. are not "current conductor portions" at all. Applicants also submit that the lead frame of Stauth et al. has a uniform thickness.

For reasons similar to those described above in conjunction with Claim 13, Applicants submit that independent Claim 25 is patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "...a current conductor portion comprising a coupling of at least two of the plurality of leads, *at least a portion of the current conductor portion having a cross section with a predetermined shape selected to provide an increased flux density*," as set forth in Claim 25. The Examiner makes no specific comment about Claim 25.

With this particular arrangement, in some embodiments, the cross section of the portion of the current conductor can have a reduced minimum dimension, as set forth in dependent Claim 27. In other embodiments, the shape can be, for example, a T-shape as shown in FIG. 9A and as set forth in dependent Claim 26, which claim the Examiner indicated to contain allowable subject matter. The same advantages described above in conjunction with Claim 13 apply to the claimed predetermined shape of Claim 25. While this arrangement is described in conjunction with FIGS. 9 and 9A, it should be appreciated that the same arrangement applies to any of the embodiments shown in the other figures, including FIG. 6, which was elected in response to a Restriction Requirement mentioned above. In particular, at page 17, lines 25-26, in referring to FIG. 9, the specification states "...a lead frame 250 is shown having a shape similar to the lead frame 72 of FIG. 3 and the lead frame 152 of FIG. 6." Therefore, it will be understood that the lead frame 250 of FIG. 9, which shows the claimed arrangement of Claim 25, can be used in the arrangement of FIG. 6.

In contrast, current path 5 of Steiner et al. has a cross section with a uniform rectangular shape throughout the current path, which does not provide an increased flux density. Rather, the

uniform rectangular shape of Steiner et al. is selected in accordance with that which is provided by a conventional uniformly thick lead frame. Furthermore, as described above, Stauth et al. has no current conductor portion at all, which is formed by a coupling of at least two of the leads. Even if the conductors of Stauth et al. (e.g., conductor 364 of FIG. 6A) were current conductor portions as claimed, and they are not, still, there is no mention in Steiner et al. or in Stauth et al. as to selecting a shape of a cross section of a conductor to provide an increased flux density.

In view of the above, Applicants submit that independent Claim 25 is patentably distinct over Steiner et al. in view of Stauth et al.

Claims 27 and 28 depend from and thus include the limitations of Claim 25. Thus, Applicants submit that Claims 27 and 28 are patentably distinct over the cited reference at least for the reasons discussed above in conjunction with Claim 25.

For substantially the same reasons discussed above in conjunction with Claim 13, Applicants submit that Claim 27 is further patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "... *the cross section is generally rectangular having a smallest dimension less than a thickness of said lead frame*," as set forth in Claim 27.

For substantially the same reasons discussed above in conjunction with Claim 1, Applicants submit that Claim 28 is further patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "... each one of the leads has *a bend in a direction selected to result in each one of the leads being closer to the first surface of the substrate than to the second surface of the substrate throughout a length of the lead*," as set forth in Claim 28.

Applicants submit that amended independent Claim 29 is patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither

describe nor suggest "...one or more magnetic field transducers disposed on the first surface of said substrate and *proximate to the loop such that the one or more magnetic field transducers are responsive to a current flowing through the loop*... ," as set forth in amended Claim 29.

With this particular arrangement the claimed current conductor portion (e.g., 154, FIG. 6) can have a loop (leads 152a, 152b to leads 152c, 152d) and a magnetic field transducer 158 is proximate to the loop and responsive to a current passing through the loop. In contrast, the current path 5 of Steiner et al. has no loop proximate to the Hall generators 2. As described above, Stauth et al. has no current conductor portion at all, which is formed by a coupling of at least two of the leads.

In view of the above, Applicants submit that independent Claim 29 is patentably distinct over Steiner et al. in view of Stauth et al.

Claims 30, 32, and 33 depend from and thus include the limitations of Claim 29. Thus, Applicants submit that Claims 30, 32 and 33 are patentably distinct over the cited references at least for the reasons discussed above in conjunction with Claim 29.

Applicants submit that Claim 30 is further patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "... *at least one of the one or more magnetic field transducers is disposed within the inner dimension* ... ," as set forth in Claim 30. With this particular arrangement, in some embodiments, the claimed current conductor portion (e.g., 154, FIG. 6) can have a loop as shown, inside of which a magnetic field transducer 158 is disposed.

For substantially the same reasons discussed above in conjunction with Claim 13, Applicants submit that Claim 32 is further patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest

"... *at least a portion of said current conductor portion has a generally rectangular cross section having a smallest dimension less than a thickness of said lead frame*," as set forth in Claim 32.

For substantially the same reasons discussed above in conjunction with Claim 1, Applicants submit that Claim 33 is further patentably distinct over Steiner et al., whether taken alone or in combination with Stauth et al., since the cited references neither describe nor suggest "... *each one of the leads has a bend in a direction selected to result in each one of the leads being closer to the first surface of the substrate than to the second surface of the substrate throughout a length of the lead*," as set forth in Claim 33.

In view of the above, Applicants submit that the rejection of 1, 9-11, 13-18, 25, 27-30, 32, and 33 under 35 U.S.C. §103(a) should be removed.

The Claim Objections

The Examiner objects to Claims 12, 26, and 31 as being dependent upon a rejected base claim, but indicates that Claims 12, 26, and 31 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claim.

For the above reasons, Applicants submit that independent Claim 1, from which Claim 12 depends, independent Claim 25, from which Claim 26 depends, and independent Claim 29, from which Claim 31 depends, are patentably distinct over the cited references. Therefore, Applicants submit that Claims 12, 26, and 31 are allowable in their present dependent form.

Claims 36-38 are new in the application. Consideration of new Claims 36-38 is respectfully requested.

In view of the above Amendment and Remarks, Applicants submit that the claims and the entire case are in condition for allowance and should be sent to issue and such action is respectfully requested.

The Examiner is respectfully invited to telephone the undersigning attorney if there are any questions regarding this Amendment or this application.

The Assistant Commissioner is hereby authorized to charge payment of any additional fees associated with this communication or credit any overpayment to Deposit Account No. 500845, including but not limited to, any charges for extensions of time under 37 C.F.R. §1.136.

Respectfully submitted,

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